Environmental Protection Agency

Dynamometer Shaft Encoder Calibration Procedure

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NVFEL Reference Number

035A

Implementation Approval

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Revision Description

(1) 09-18-2001 The purpose of this change is to update the Group Responsible name per EPCN #316

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1. Purpose

The purpose of this procedure is to document the steps required to perform the dynamometer shaft encoder calibration for PNGV cells.

2. Test Procedure

101 Go to the mezzanine above the test cell and turn off, lock, and tag out the main switch for the Meidensha dynamometer. See Figure 1.

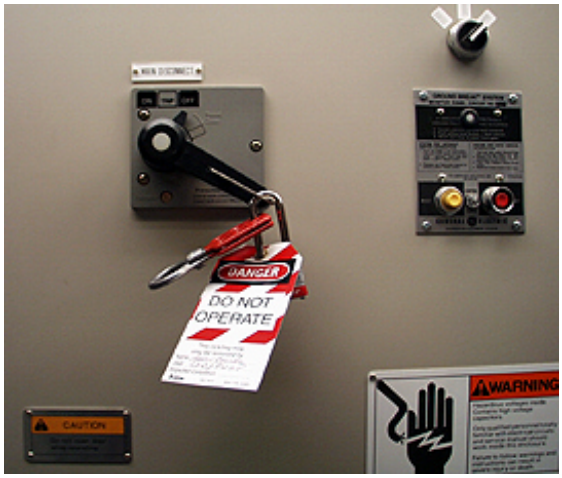

Figure 1
Lock-out Main Switch

102 Press E Stop, the mechanical red emergency button.

103 Ensure that the drive shaft is disconnected. If it is in place, remove the four bolts holding the cover in place, and then remove the cover plate.

In some cells, you can only remove 2 bolts, and then the cover can be raised while it remains attached on the one side.

104 Remove the 4 bolts connecting the drive shaft mounting flange to the dynamometer.

Use a pry-bar to disengage the drive shaft from its seat, so that it is not touching the dynamometer shaft. See Figure 2. Unbolt the drive shaft enclosure from the bed plate and slide away from the dyno hub.

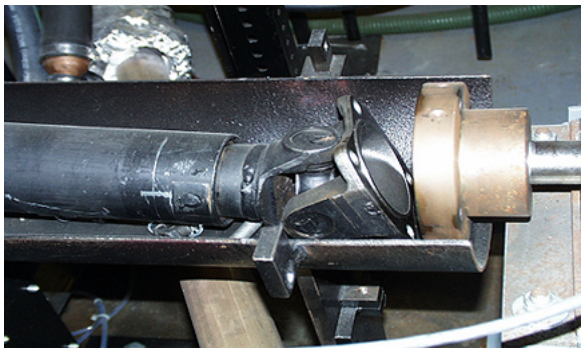

Figure 2
Disengaged Drive shaft

105 If the PowerTek VX-In Engine controller computers and monitor are not turned on, follow WP 031 “PNGV Start VX-In” for the startup procedure.

106 Open the "Displays" toolbar on the controller monitor and select “Special” then select “Calibrate”.

107 On the “Calibrate” screen, scroll up or down the “Channel Names” until “tqSHAFT” appears. See Figure 3. Double click on “tqSHAFT”.

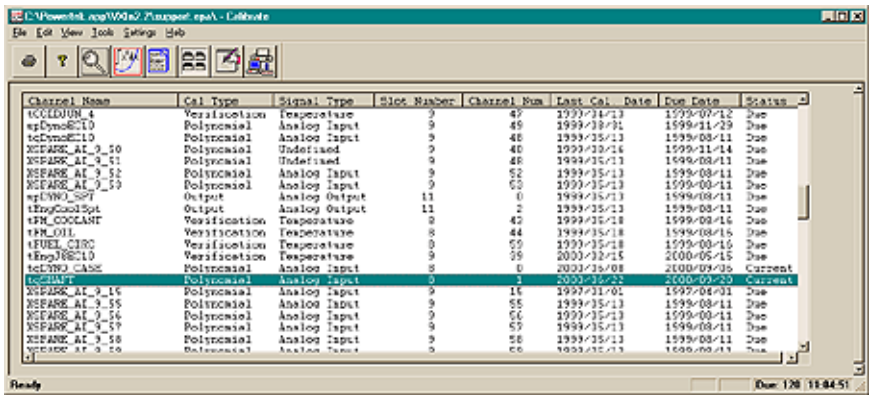

Figure 3
Calibrate Screen

108 “Operator ID” prompt will appear. Enter the operator ID and press “OK”. Verify that the channel name is ”tqSHAFT” The “Signal Display” screen will appear.

109 Observe the "Raw Value" on the "Signal Display" screen. Record for later use.

110 In the test cell, attach the dyno lock down fixture to the back of the dynamometer shaft to prevent shaft rotation. Attach two bolts to the hub and adjust the threaded rods. See Figure 4.

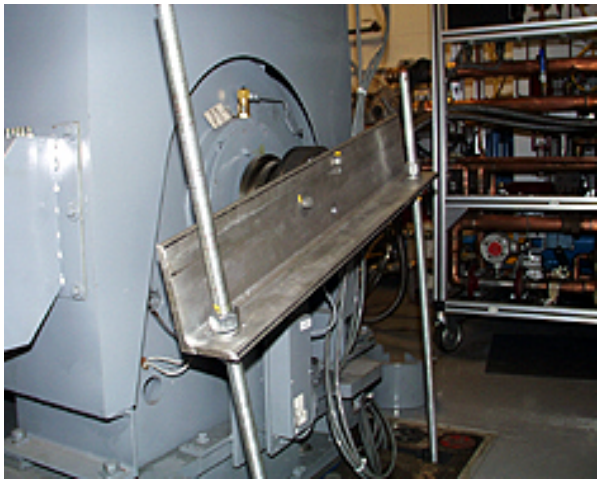

Figure 4
Dyno Lockdown Fixture

110 Attach the shaft calibration arm to the dyno drive hub with four bolts. See Figure 5.

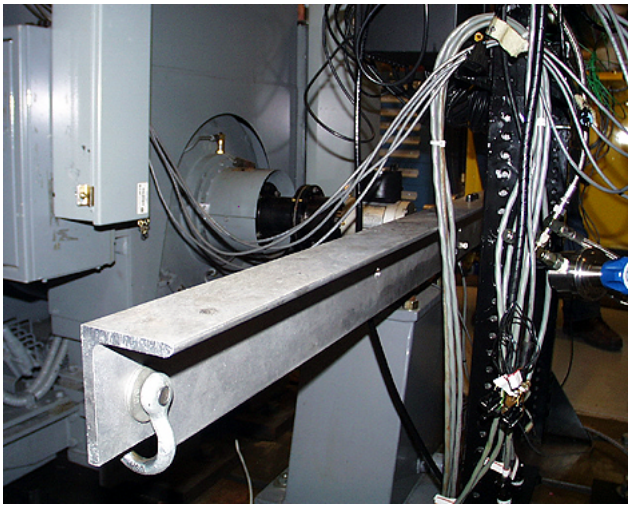

Figure 5
Shaft Calibration Arm

111 While observing the level on the top of the calibration arm, adjust the threaded rods on the fixture until the calibration arm is level.

112 Go to the control room. Observe the "Raw Value" on the Signal Display Screen. Verify that the "Raw Value" with the bar and "Raw Value" recorded in Step 109 agree to within 0.2 % of full range.

If it is within tolerance, select the field area for "Polynomial Order" by double-clicking on it and type in '3'. See Figure 6.

If it is not within tolerance, remove the shaft calibration arm and go to Step 110. If, after a second attempt, it is not within tolerance, notify the senior technician.

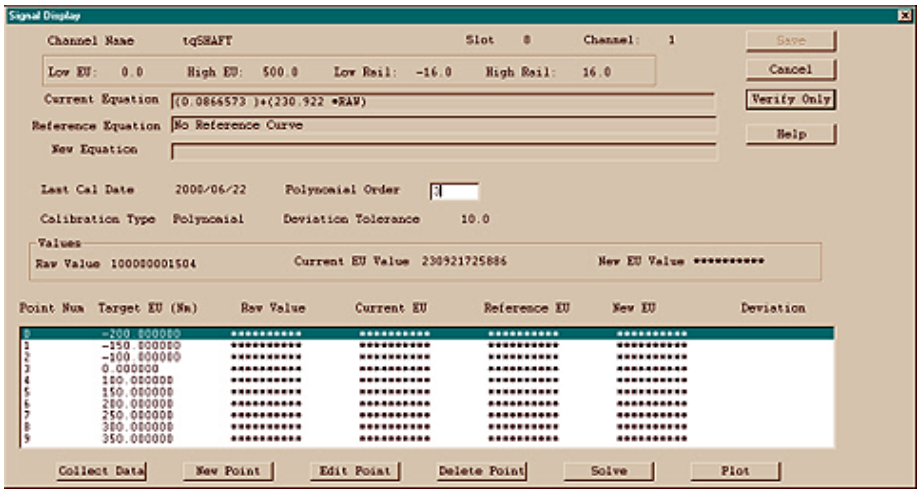

Figure 6
Signal Display Screen

113 In the bottom panel of the "Signal Display" screen, verify that "Target EU" 0.000000 is listed. If it is listed, highlight it and click on the "Collect Data" button. A raw value will appear next to "Target EU".

114 If the Target EU 0.000000 is not listed on the Signal Display screen, click on "New Point" button. The "Setpoint Editor" window for Target EU will appear. See Figure 7.

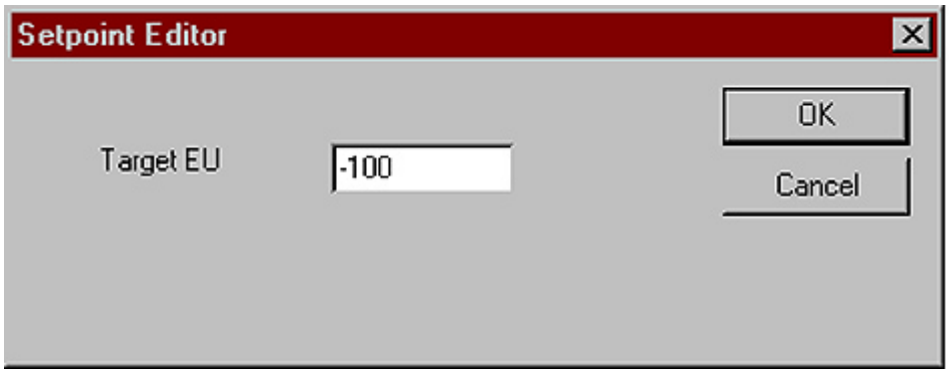

Figure 7
Setpoint Editor

115 Select the entry window for Target EU by clicking the mouse on it. Then type in "0.00" and click on "OK". When the "Signal Display" screen appears, highlight Target EU "0.000000" and then click on the "Collect Data" button. A raw value will appear next to "Target EU".

In preparation for adding weights on the arms, the determination of positive and negative changes relies on the direction of the arrow point on the drive shaft mount. The arrow points to the positive side. See Figure 8.

Figure 8
Direction Arrow

116 In the cell, attach the hang basket to the negative side arm of the drive shaft. The basket represents 100 Newton-meters. Once attached, tap on it to remove hysteresis.

117 In the bottom panel of the “Signal Display” screen, verify that Target EU “-100” is listed. If it is listed, highlight it and click on the “Collect Data” button. A raw value will appear next to “Target EU”.

118 If the Target EU -100 is not listed on the Signal Display screen, click on “New Point” button. The Setpoint Editor for Target EU will appear.

Select the entry window for Target EU by clicking the mouse on it. Then type in “-100” and click on “OK”.

When the “Signal Display” screen appears, highlight Target EU “-100” and then click on the “Collect Data” button. A raw value will appear next to the “Target EU”.

119 In the cell, add a second weight which represents 100 Newton-meters to the hang basket for a total of -200 Newton-meters. Once attached, tap on it to remove hysteresis.

120 In the bottom panel of the “Signal Display” screen, verify that Target EU ‘-200’ appears.

If it is listed, highlight it and click on the “Collect Data” button. A raw value will appear next to “Target EU”.

121 If the Target EU -200 is not listed on the “Signal Display” screen, click on “New Point” button. The “Setpoint Editor” window for Target EU will appear.

Select the entry window for Target EU by clicking the mouse on it. Then type in “-200” and click on “OK”.

When the “Signal Display” screen appears, highlight Target EU “-200” and then click on the “Collect Data” button. A raw value will appear next to “Target EU”.

122 In the cell, add a third weight which represents 100 Newton-meters to the hang basket for a total of -300 Newton-meters. Once attached, tap on it to remove hysteresis.

123 In the bottom panel of the “Signal Display” screen, verify that “Target EU” -300 is listed. If it is listed, highlight it and click on the “Collect Data” button. A raw value will appear next to “Target EU”.

124 If the “Target EU” -300 is not listed on the “Signal Display” screen, click on the “New Point” button. The “Setpoint Editor” window for “Target EU” will appear.

Select the entry window for Target EU by clicking the mouse on it. Then type in “-300” and click on “OK”.

When the “Signal Display” screen appears, highlight Target EU “-300” and then click on the “Collect Data” button. A raw value will appear nest to the “Target EU”.

125 In the cell, add two more weights that represent 100 Newton-meters each and a weight that represents 50 Newton-meters to the hang basket for a total of -550 Newton-meters. Once attached, tap on it to remove hysteresis.

126 In the bottom panel of the "Signal Display" screen, verify that "Target EU" -550 is listed. If it is listed, highlight it and click on the "Collect Data" button. A raw value will appear next to "Target EU".

127 If the Target EU -550 is not listed on the "Signal Display" screen, click on "New Point" button. The "Setpoint Editor" window for Target EU will appear.

Select the entry window for Target EU by clicking the mouse on it. Then type in "-550" and click on "OK".

When the "Signal Display" screen appears, highlight Target EU "-550" and then click on the "Collect Data" button. A raw value will appear next to "Target EU".

128 Begin removing the weights, one by one, in the order they were added and check the raw value with each removal. Each time the weight is detached, tap on the basket to remove hysteresis.

On the screen, check the raw value with each removal. The raw value should match the current EU value for each weight within ± 1% of the total value. Once all the weights are removed from the negative side, repeat the calibration process on the positive side.

129 In the cell, attach the hang basket to the negative side arm of the drive shaft. The basket represents 100 Newton-meters. Once attached, tap on it to remove hysteresis.

130 In the bottom panel of the "Signal Display" screen, verify that "Target EU" 100 is listed. If it is listed, highlight it and click on the "Collect Data" button. A raw value will appear next to "Target EU".

131 If the Target EU 100 is not listed on the "Signal Display" screen, click on "New Point" button. The "Setpoint Editor" window for Target EU will appear.

Select the entry window for Target EU by clicking the mouse on it. Then type in "100" and click on "OK".

When the "Signal Display" screen appears, highlight Target EU "100" and then click on the "Collect Data" button. A raw value will appear next to "Target EU".

132 In the cell add a second weight which represents 100 Newton-meters to the hang basket for a total of 200 Newton-meters. Once attached, tap on it to remove hysteresis.

133 In the bottom panel of the “Signal Display” screen, verify that “Target EU” 200 is listed. If it is listed, highlight it and click on the “Collect Data” button. A raw value will appear next to “Target EU”.

134 If the Target EU 200 is not listed on the “Signal Display” screen, click on “New Point” button. The “Setpoint Editor” window for Target EU will appear.

Select the entry window for Target EU by clicking the mouse on it. Then type in “200” and click on “OK”.

When the “Signal Display” screen appears, highlight Target EU “200” and then click on the “Collect Data” button. A raw value will appear next to “Target EU”.

135 In the cell, add a third weight which represents 100 Newton-meters to the hang basket for a total of 300 Newton-meters. Once attached, tap on it to remove hysteresis.

136 In the bottom panel of the “Signal Display” screen, verify that “Target EU” 300 is listed. If it is listed, highlight it and click on the “Collect Data” button. A raw value will appear next to “Target EU”.

137 If the Target EU 300 is not listed on the “Signal Display” screen, click on “New Point” button. The “Setpoint Editor” window for Target EU will appear.

Select the entry window for Target EU by clicking the mouse on it. Then type in “300” and click on “OK”.

When the “Signal Display” screen appears, highlight Target EU “300” and then click on the “Collect Data” button. A raw value will appear next to “Target EU”.

138 In the cell, add a fourth weight which represents 100 Newton-meters to the hang basket for a total of 400 Newton-meters. Once attached, tap on it to remove hysteresis.

139 In the bottom panel of the “Signal Display” screen, verify that “Target EU” 400 is listed. If it is listed, highlight it and click on the “Collect Data” button. A raw value will appear next to “Target EU”.

140 If the Target EU 400 is not listed on the “Signal Display” screen, click on “New Point” button. The “Setpoint Editor” window for Target EU will appear.

Select the entry window for Target EU by clicking the mouse on it. Then type in “400” and click on “OK”. When the “Signal Display” screen appears, highlight Target EU “400” and then click on the “Collect Data” button. A raw value will appear next to “Target EU”.

141 In the cell, add another weight that represents 100 Newton-meters and a weight that represents 50 Newton-meters to the hang basket for a total of 550 Newton-meters. Once attached, tap on it to remove hysteresis.

142 In the bottom panel of the "Signal Display" screen, verify hat "Target EU" 550 is listed. If it is listed, highlight it and click on the "Collect Data" button. A raw value will appear next to "Target EU".

143 If the Target EU 550 is not listed on the "Signal Display" screen, click on "New Point" button. The "Setpoint Editor" window for Target EU will appear.

Select the entry window for Target EU by clicking the mouse on it. Then type in "550" and click on "OK".

When the "Signal Display" screen appears, highlight Target EU "550" and then click on the "Collect Data" button. A raw value will appear next to "Target EU".

144 Begin removing the weights, one by one, in the order they were added and check the raw value with each removal. Each time the weight is detached, tap on the basket to remove hysteresis.

On the screen, check the raw value with each removal. The raw value should match the current EU value for each weight within ± 1% of the total value.

145 Once all the positive weights are removed, click on the "Solve" button. Verify that you have new EU numbers in the panel.

146 Click on the "Plot" button.

147 The “Cal Plot for tqSHAFT” appears. See Figure 9. Verify that the plot forms a straight line.

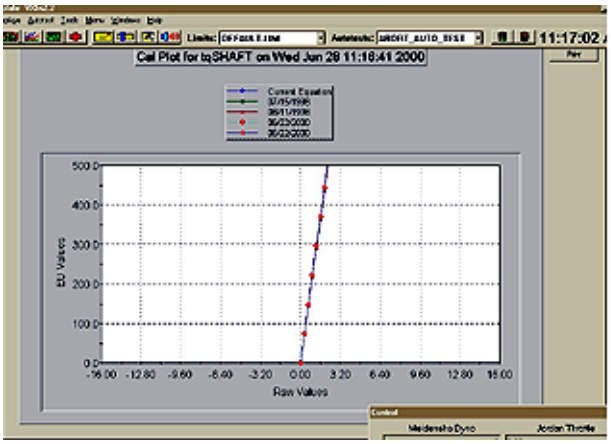

Figure 9
Cal Plot for tqSHAFT

148 In the upper right corner of the “CalPlot” display, press the “Print” button.

149 Click on the “OK” button of the Cal Plot display to return to the Signal Display screen.

150 Click on “Save” button of the Signal Display to return to the “Calibrate” screen.

151 On the “Calibrate” screen, select “Tools” menu, and from the menu select “View Calibration History”.

152 Ensure that “tqSHAFT” appears on the “Review History” screen in the “Channel Name” box. See Figure 10.

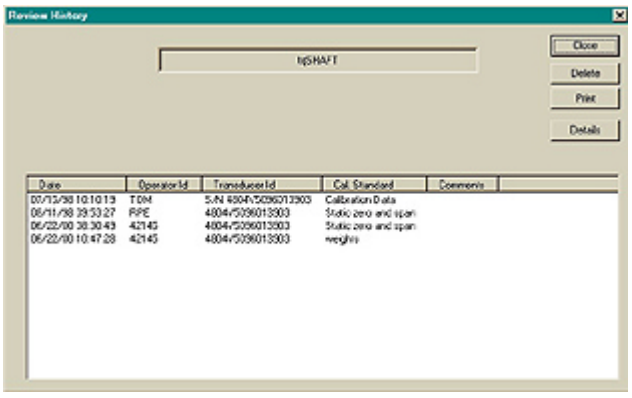

Figure 10
Review History Screen

153 From the list in the bottom display, highlight the calibration that was just performed.

154 Click on the “Print” button in the upper right hand corner.

155 Click “OK” when the “Print” screen appears.

156 A calibration report will be printed. On the “Review History” screen, click “Close”.

157 On the “Calibrate” screen, click on the “File” menu and select “EXIT”.

158 In the cell, remove the calibration arms and hold down fixture for the dyno, and return them with the bolts to their storage location.

159 Re-attach the drive shaft to dynamometer by loosely threading the bolts to the mounting flange.

160 Tighten one bolt with a torque wrench to 65 ft.-lb..... Use a pry bar to rotate the drive shaft.

161 Tighten with a torque wrench, the bolt opposite the first one to 65 ft-lb. Use a pry bar to rotate the drive shaft.

162 Use the torque wrench to tighten the third bolt to 65 ft-lb. Use a pry bar to rotate the drive shaft.

163 Tighten the remaining bolt with the torque wrench to 65 ft-lb.

164 Repeat the procedure used in Steps 160-162 to tighten the four bolts with a torque wrench to 75 ft-lb.

165 Move the drive shaft to its original position.

166 Replace the drive shaft cover by securing either the removed four or the removed two bolts back to it.

167 Shut down the computer by following the steps in WP 032 “PNGV Stop VX-In”.

168 Staple the “Cal Plot for tqSHAFT” and “Calibration Summary” printouts together and place them in the “Dynamometer Calibrations Records” cabinet.

169 Go to the mezzanine and remove the lock and lockout tag from the Meidensha dynamometer main switch. Turn on the power to the dynamometer.

170 Turn the E Stop mechanical red emergency button until it releases.

3. Acceptance Criteria

3.1 The raw value must match the current EU value for each weight within ± 1% of the total value.

3.3 The Cal Plot data visually forms a straight line.

3.4 The Cal Plot for tqSHAFT" and "Calibration Summary" printouts are filed in the "Dynamometer Calibrations Records" cabinet.

3.5 The four bolts to the mounting flange are tightened to 75 ft.-lb.